**pH scale**

Some students are discussing what the pH of a solution tells you.

**Monica:** pH tells you how acidic a solution is.

**Priyanka:** pH tells you the strength of an acid or alkali.

**Lucy:** The lower the pH, the more dangerous the solution.

**Chantelle:** pH tells you how acidic or alkaline a solution is.

1. Who do you agree with, and why?

|  |  |
| --- | --- |
| Cards for  **pH scale** |  |
| **Monica:** pH tells you how acidic a solution is. | **Priyanka:** pH tells you the strength of an acid or alkali. |
| **Lucy:** The lower the pH, the more dangerous the solution. | **Chantelle:** pH tells you how acidic or alkaline a solution is. |

|  |  |
| --- | --- |
| Cards for  **pH scale** |  |
| **Monica:** pH tells you how acidic a solution is. | **Priyanka:** pH tells you the strength of an acid or alkali. |
| **Lucy:** The lower the pH, the more dangerous the solution. | **Chantelle:** pH tells you how acidic or alkaline a solution is. |

*Chemistry > Big idea CSU: Substances and properties > Topic CSU3: Acids and alkalis > Key concept CSU3.1: pH scale*

|  |
| --- |
| **Diagnostic question** |
| **pH scale** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Acidic and alkaline solutions may be compared using the pH scale. |
| Observable learning outcome: | Interpret the pH scale. |
| Question type: | talking heads |
| Key words: | acid, alkali, pH scale |

**What does the research say?**

The research reveals a range of misunderstandings about the pH scale. Cros et al (1986) and Sheppard (2006) found that some students thought that pH was a measure of acidity. These students did not consider alkalinity at all. Nakhleh and Krajcik (1994) reported that some students considered pH to be inversely related to harm. This could indicate misunderstanding of the pH scale or the dangers of alkalis.

Research by Sheppard (2006) and Demiricioğlu et al. (2005) revealed that some students linked pH to the strength of the acid or alkali. This is not surprising as this terminology is frequently used in teaching and published resources. However, this research related to older students who should have been familiar with the concept of strong and weak acids. This raises the possibility that the use of language in earlier teaching may result in misunderstandings later.

**Ways to use this question**

This task is intended for discussion in pairs or small groups. It can be done as a pencil and paper exercise or projected onto a screen.

Students should read the statements and follow the instructions on either the worksheet or the PowerPoint. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as the scribe. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**

The student giving the most scientific answer, at this level, is Chantelle. pH tells you how acidic or alkaline a solution is.

**How to respond - what next?**

A student who agrees with Monica, that pH tells you how acidic a solution is may lack understanding or familiarity with alkalis. The same may be the case if a student agrees with Lucy that the lower the pH, the more dangerous the solution. For these students it may be helpful to emphasise that the pH scale works in two directions with both low pH and high pH representing the extremes (the most acidic and the most alkaline solutions respectively). It is important that students are aware that alkalis can also be dangerous.

A student who agrees with Priyanka may understand the pH scale correctly however it may be beneficial to explain that in chemistry acid or alkali strength relates to the type of acid or alkali and not the solution. So, for example, hydrochloric acid is a stronger acid than ethanoic acid (vinegar). The explanation of this in terms of disassociation of ions will be encountered later so the focus at this stage is simply on the use of language when describing acids and alkalis.

If students have misunderstandings about the pH scale comparing about both acidity and alkalinity, they may benefit further practice in using pH to compare both acids and alkalis.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Which pH?

**Acknowledgments**

Developed by Helen Harden (UYSEG.

Images: None

**References**

Cros, D. é., et al. (1986). Conceptions of first-year university students of the constituents of matter and the motions of acids and bases. *European Journal of Science Education,* 8(3)**,** 305-313.

Demircio ğlu, G. A., Alipaşa and Demircio ğlu, H. (2005). Conceptual change achieved through new teaching program on acids and bases. *Chemistry Education Research and Practice,* 6(1)**,** 36-51.

Nakhleh, M. B. and Krajcik, J. S. (1994). Influence of levels of information as presented by different technologies on students' understanding of acid, base and pH concepts. *Journal of Research in Science Teaching,* 31(10)**,** 1077-1096.

Sheppard, K. (2006). High school students' understanding of titrations and related acid-base phenomena. *Chemistry Education Research and Practice,* 7(1)**,** 32-45.